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SCIENCE

NEW YORK, JUNE 30, 1893.

THE EVOLUTION OF CONSCIOUSNESS AND OF THE CORTEX.

BY C. L. HERRICK, PROFESSOR OF BIOLOGY IN DENISON UNIVERSITY, GRANVILLE, OHIO.

IT would be difficult to find an illustration of the mutual interdependence of the biological sciences more striking than that afforded by the recent contributions from morphology, embryology, physiology, and pathology to our knowledge of the significance of the cerebrum.

It has been customary to scout at any substantial contribution to psychology from the experimental sciences, and even now, when so much attention is given to psycho-physics or physiological psychology, far too little use is made of the data of modern embryology and histology. It should be apparent to all who are not *a priori* convinced that no relation exists between consciousness and the nervous system, that no satisfactory super-structure can be reared upon any other foundation than that afforded by a minute study of the structure and function of the brain.

It is the great triumph of modern embryological histology, with Professor His as its leader, to have discovered the essential similarity of all nervous elements. What Schwann did for biology at large by means of the cell theory, Professor His has done for neurology through his theory of the neuroblast and its supplement, the "neuron theory."

It was inevitable that we should soon recognize the essential similarity in origin and structure of all nervous cells. The present writer has insisted for some years that the entire fabric of the nervous system, with the exception of a few connective and nutritive elements of secondary nature, is woven by the interblending of neurons of similar character. All such neurons are formed from the epiblast or its derivatives (the perplexing relations of the sympathic system aside). Each neuron arises from neuroblasts or formative cells springing from the ectal surface (ventricular surface by invagination in the case of the axial nervous system), and, after migration to its definitive site, takes on its distinctive character. It has been attempted to show that these are all transitions between the neuroblast and the wonderful variety of nervous elements. The nerves, whether springing from a special ganglion or from the neuraxis itself, are formed, in our view, from the moniliform union of neuroblasts, whose nuclei, when they have served their purpose in forming the fibre, become separated to form the nuclei of the sheath. The recent researches in nerve degeneration and histogenesis all favor this view.

Besides those elements which at once become transformed into the definitive nerve cells, we believe there are intermediate conditions or "reserves," which may subsequently be called into function. Upon this view there is a continuous intercallation of nervous elements going on — a process much more rapid during youth. From the same standpoint it seems probable that there are numerous proliferating stations, where such neurons are continually forming. In the cerebellum and medulla, and even in the cerebrum itself, there are such loci of rapid development. No exception has so far been encountered to the law that the neurons of the central system all spring directly or indirectly from the ventricular surface.

An attentive comparative study of the various groups of vertebrates shows that the development of the various parts of the brain obeys simple and readily discoverable laws, which, when recognized, are as self-evident as the gastræa formation of the embryo. The modifications of the brain-tube, from its primitive uniformity to the wonderful complexity to which it attains in man, form a consecutive series without any complexing hiatus.

Interest attaches particularly to the cerebrum, by reason of its preëminent position, as the latest structural modification, and its close relation to the phenomena of consciousness. Since Rückhard showed that in the fish the roof or cortex of the cerebrum is wanting, or rather represented by a non-nervous membranous pallium, considerable modifications in our conceptions of the sphere of consciousness have been rendered necessary. Remarkable experiments show that the whole cerebrum may be removed without making any noticeable difference in the habits and activities of the fish (save in the case of those functions associated with smell). The writer has studied the axial lobe of the cerebrum of fishes and described numerous distinct cell-clusters and tracts which had hitherto been overlooked. He suggested that the undifferentiated prototypes of the cell-masses, which in higher vertebrates occupy the cortex, are, in this case, retained in the axial lobes. It was shown that the centres for the sense of smell are highly and specially developed, and are connected by strong and distinct tracts with the olfactory organs. It was even ventured to locate a homologue of the hippocampus upon the basis of the tracts. This procedure was evidently regarded by some as rash, but has been amply justified by subsequent developments.

In reptiles we located the olfactory centre or hippocampal lobe in a large part of the cortex, which is closely associated with a curiously modified part of the axial lobe. We suggested that the cortical elements arise as proliferations from the axial lobe, which push out into the thin cortical walls or pallium. In the *Leuckart Festschrift* it was shown that the preplexus in amphibia is analogous in early position and structure to the pallium of fishes.

In a recent number of the *Anatomischer Anzeiger* Dr. Edinger, who is perhaps the ablest living comparative neurologist, works out this form of the solution of this problem in detail with respect to the olfactory and hippocampus. Accepting the suggestion of proliferation from the axial lobe, he shows that the earliest cortex to be formed is that which, in higher vertebrates, is termed ammonshorn or hippocampus. In other words, consciousness first intervenes in the construction of data from the olfactory sense. This suggestion is enforced by the data of comparative morphology. The olfactory is the most primitive of the special sense-organs, and is most closely associated with the cerebrum.

Several years ago we proposed the theory that consciousness must have appeared very late in the evolution of psychical functions; the higher expressions of this faculty, such as reflection, being among the latest endowments of the race. It was shown that such a view would give us less concern in the bloodthirsty procession of ferocious animals which have reddened every page of geologic history. When the greatest diameter of the nerve-tube was in the pelvic region, it was unnecessary to predicate consciousness as a pre-requisite to the simple avocations of the animal.

We believe that, under the law of natural selection, consciousness could only appear when the arena was opened for its serviceable exercise.

Remarkable confirmation of the comparatively accessory status of consciousness has been obtained from two such different sources as the study of hypnotism and experimental psychology. In a most interesting paper printed in the June number of the *Journal of Comparative Neurology* Dr. Edinger describes the results of an examination of the brain of a dog, from which Professor Goltz had removed the *entire cerebrum on both sides*.

The dog lived eighteen months, but, contrary to the predictions of the sceptical, the cerebrum proved to be all but entirely removed. The special senses were not destroyed except smell. Locomotion was not impaired, and general sensation was intact.

Although the animal was completely imbecile, it retained the nervous mechanism for nearly all bodily functions. While these results seem, at first, contradictory to those derived from extirpation and electrical stimulation, yet, as Edinger shows, they merely indicate that the organs and processes of consciousness are merely superposed upon the substructure of the instinctive processes and axial centres.

In man, who has acquired greater dependence upon reflection and other higher functions, the primitive independence of the lower centres is retained for a relatively short time during childhood. The above illustration may at least serve to show how mutually dependent all these sciences are and that we seem to be gradually approximating toward a connected theory of nervous action and evolution.

SOME CURRENT NOTES UPON METEORITES.

BY S. C. H. BAILEY, OSCAWANA-ON-HUDSON, N.Y.

IT may well be hoped that the revived attention which has recently been shown in the study of that interesting class of bodies known as meteorites, will result in giving us a more practical, if not a more certain, basis for their consideration. If in the onset we meet with conflicting theories and much uncertain data, we are only upon the same ground where most scientific inquiry begins. If we cannot tell whence an aerolite comes, we usually do know the fact and date of its fall, its chemical and lithological composition, specific weight and peculiarities of structure, the phenomenon attending its flight, and often the precise radiant point from whence it came. We hold the object in our hands, and can study its physical properties, and its cosmic as well as its telluric history. All these particulars have been observed, compared, studied, and in part determined by thoroughly competent scientific men, and yet, to-day, there is no accepted scientific name to indicate their special line of research, none for this department of science itself. These primary needs are yet to be filled. Heretofore two distinguished writers and students in this field of inquiry have each proposed a specific name for the science, and, while neither of the terms seems to be objectionable, neither of them seems to have been generally adopted or used. In 1847 Shepard proposed the term "Astropetrology," and in 1863 Story-Maskelym suggested that of "Aerolitics" to distinguish it as a department of science. Both from the priority of suggestion, and as a fitting tribute to the zeal and valuable labors of Professor Shepard in that behalf, will it not be proper and convenient to adopt his proposed name, astropetrology, which, in accordance with common usage, by a simple change of its final syllable "gy" into "gist," will also designate a person devoted to its study? How comes it that a subject presenting most interesting and possibly serviceable problems in astronomy and physics should thus far be deficient in the very rudiments of a distinctive science — even a name? Certainly not from lack of patient labor and intelligent investigation by thoroughly competent men. Smith and Genth upon its chemical side, and Newton, Eastman, Langley, Kirkwood, and others upon its astronomical, have, in our country, done much to determine the data upon which present theories rest; while abroad, among a host of others, Haidenger, Meunier, Tschermak, and Brazina have worked at the very bases of efficient progress in scientific research, investigation, and the classification of the objects themselves. In this last-mentioned feature, however, lies a discouraging fact. These several systems do not agree, or rather, while serviceable and consistent in themselves, they, to some extent, seem to antagonize each other in the hands of the collector or possessor of meteoric examples. In a given example not properly labelled, or when labels have been confused, and perhaps changed places, its possessor will probably find it quite accurately described upon reference to one of these systems, but from caution, upon reference to another system, he will find described peculiarities not seen in, and possibly antagonistic to, the same fall as that which he has in hand. How is he to identify it? Specific weight may help the determination, but, standing alone, it cannot be conclusive. Chemical analysis is impracticable and not wholly conclusive. Now, if the absolute necessity of accuracy in the identification of the fall is considered for a moment, there will also result a partial appreciation of its vast importance in all its collateral as well as direct relations. For instance, the supposed example almost exactly resembles another described fall, but one occurred in India, A.D. 1822, while the other fell in Iowa in 1847, both were well observed as to radiant point, time, and course of flight, but each was the reverse of the other in all these important particulars; in short, they only resemble each other in physical characters, and a confusion of their identity may destroy all their value as data in their theoretical and astronomical relations. Identity of radiant point, time, and course of flight and a possible periodicity in observed falls will interest the astronomer even more than identity of chemical composition or physical characters, though each is a factor in his theory, and each must be, if possible, an observed fact. If a single fact may uphold or upset a theory, it should certainly be an observed fact. The purpose of these observations is to inquire what may be done to base investigations of these wonderful phenomena, the most suggestive and impressive of nature's visible displays, and the objects which they bring to us from the regions of space, upon ground more worthy of consideration and research, than as merely objects of a collecting fad, or a money-making zeal in collecting and selling examples. May we not begin by some practical methods for determining and perpetuating the identity of each example by describing and authenticating with the greatest exactness every fall and every fragment? For accomplishing this purpose the number of examples is already large, but it will be constantly augmented by new accessions which may present new physical features and new, perhaps more definite, data, the value of which will be carefully determined by the astronomer and chemist, and probably with greater fidelity and accuracy than by the observer who witnessed its fall, or the author who has the example in his hand from which to write its description. In a subsequent paper I shall venture to suggest some simple expedients for avoiding some defects and errors which have become a great and increasing obstacle to progress in this most interesting department of science.

BIOLOGY IN OUR COLLEGES: A PLEA FOR A BROADER AND MORE LIBERAL BIOLOGY.

BY C. HART MERRIAM, WASHINGTON, D.C.

WHEN it became fashionable to study physiology, histology, and embryology, the study of systematic natural history was not only neglected, but disappeared from the college curriculum, and the race of naturalists became nearly extinct. Natural history, as formerly understood, comprised geology, zoölogy, and botany, and persons versed in these sciences were known as naturalists. Geology gradually came to occupy an independent field, and is now everywhere taught separately; hence, for present purposes, it may be dismissed, with the reminder that the naturalist who knows nothing of geology is poorly equipped for his work. A knowledge of the two remaining branches — the biological branches — was looked upon as sufficient to constitute a naturalist. But the kind of knowledge taught underwent a change; the term "naturalist" fell into disuse to be replaced by "biologist," and some would have us believe that even the meaning of the word biology is no longer what it was. Systematic zoölogy has gone, or, if still tolerated in a few colleges, is restricted to a very subordinate position. Systematic botany is more fortunate, still holding an honored place in many universities, though evidently on the wane.

Is it not time to stop and inquire into the nature of the differences between the naturalist and the modern school of instructors who call themselves "biologists;" into the causes that have brought about so radical a change, and into the relative merits, as branches of university training, of systematic biology compared with the things now commonly taught as biology?

Is it not as desirable to know something of the life-zones and areas of our own country with their principal animals and plants and controlling climatic conditions, as to be trained in the minute structure of the cellular tissue of a frog? And is not a knowledge

of the primary life regions of the earth, with their distinctive types, as important as a knowledge of the embryology of the crayfish?

Naturalists delight in contemplating the aspects of nature, and derive enjoyment from studying the forms, habits, and relationships of animals and plants; while most of the self-styled "biologists" of the present day direct their studies to the minute structure (histology) and development (embryology) of a few types — generally lowly forms that live in the sea — and are blind to the principal facts and harmonies of nature. Imbued with the spirit of evolution, they picture in their mind's eye the steps by which the different groups attained their present state, and do not hesitate to publish their speculations — for "they know not what they say." Their lives are passed in peering through the tube of a compound microscope and in preparing chemical mixtures for coloring and hardening tissues; while those possessing mechanical ingenuity derive much satisfaction in devising machines for slicing these tissues to infinitesimal thinness. An ordinary zoölogist or botanist is not constituted in such a way as to appreciate the eagerness and joy with which one of these section-cutters seizes a fraction of a millimetre of the ductless gland of a chick or the mesoblast of an embryonic siphonophore; nor is it vouchsafed him to really understand, though he may admire, the earnestness, devotion, unparalleled patience, and intense satisfaction with which the said investigator spends years of his life in hardening, staining, slicing, drawing, and monographing this same bit of tissue.

Such "biologists" have been well characterized by Wallace as "the modern school of laboratory naturalists" — a class "to whom the peculiarities and distinctions of species, as such, their distribution and their affinities, have little interest as compared with the problems of histology and embryology, of physiology and morphology. Their work in these departments is of the greatest interest and of the highest importance, but it is not the kind of work which, by itself, enables one to form a sound judgment on the questions involved in the action of the law of natural selection. These rest mainly on the external and vital relations of species to species in a state of nature — on what has been well termed by Semper the 'physiology of organisms' rather than on the anatomy or physiology of organs" ("Darwinism," 1890, Preface, p. vi.).

It is hardly an exaggeration to say that in our schools and colleges the generally accepted meaning of the word biology has come to be restricted to physiology, histology, and embryology, and that the courses of instruction now given in biology cover little additional ground, save that they are usually supplemented by lectures on the morphology and supposed relationships of the higher groups. It is against this modern custom of magnifying and glorifying these branches or departments of biologic knowledge until they are made to appear not only the most important part of biology, but even the whole of biology, that I beg to enter a most earnest protest. Far be it from me to deprecate any investigation that tends, in howsoever slight a degree, to increase our knowledge of any animal or plant. Such investigations fulfil an important and necessary part in our understanding of the phenomena of life, but they should not be allowed to obscure the objects they were intended to explain.

Without a knowledge of anatomy and embryology it would be impossible to properly arrange or classify the various groups, or to understand the inter-relations of the many and diverse elements that go to make up the beautiful and harmonious whole that naturalists and other lovers of nature so much admire. Similarly, the architect would be powerless to construct the magnificent edifices that everywhere mark the progress of civilization unless he understood the nature and properties of the various parts that go to make up the finished structure; yet what would be thought of a school of architecture that limited its teachings to the strength of materials or the composition of bricks, mortar, nails, and other minor factors necessary in construction? But would not such a school be strictly comparable with the modern school of histologists and physiologists who, under the head of biology, teach little besides the minute structure and functions of tissues, ignoring the characters that constitute and distinguish species, that show the adaptation of species to environment, that show the processes and steps by which species are formed, and the causes that govern their differentiation and distribution; in brief, ignoring most that is beautiful and interesting in nature, including the great truths that enable us to understand the operations and laws of nature, for the sake of dwelling eternally on details that ought to form merely a part of the foundation for a study of nature.

The evolution of these one-sided biologists is not hard to trace. Early naturalists, such as Linnæus and Buffon, knew little of the internal structure of animals and plants; their classifications, therefore, were based chiefly on external characters, and were correspondingly crude. Cuvier was first to demonstrate the importance of anatomical knowledge in arranging animals according to their natural affinities, but his studies were confined to what is now called "gross anatomy," or the structure of such parts and organs as are visible to the naked eye.

The great improvement made in the microscope in the years 1830–1832 — at which time the spherical errors that had previously rendered its use unsatisfactory were overcome by the proper adjustment of achromatic lenses — paved the way for the discoveries in embryology and the minute structure of the tissues that made illustrious the names of von Baer, Schleiden, Schwann, and a host of others. The revelations that followed created a profound sensation among the naturalists of the time, and, as the microscope became more and more perfect, new paths were opened to the investigator, and the fascination attending its use grew. The increased demand for good instruments stimulated the invention and perfection of high-power lenses and of a multitude of accessories, the use of which, in turn, led to improved methods of treating tissues and to the discovery of bacteria and the various pathogenic micrococci of fermentation and disease. A knowledge of microscopic technic became, and justly, too, a necessary qualification in the way of preliminary training for those seeking to become biologists.

The transition from the old school to the new was but a step, and had been led up to by the course of events. The older systematic naturalists rapidly died off while still appalled by the wonderful discoveries of the microscopists; the professorships in the colleges and universities (which, at the same time, were rapidly increasing in number) were filled by young men ardent in the use of the microscope, and each anxious to excel his colleague in skill and dexterity of manipulation and in the discovery of some new form of cell or new property of protoplasm.

But one result could follow the continuance of this state of affairs, namely, the obliteration of the naturalist from the face of the earth — a result that at the present moment is well-nigh attained, for, if there is an "all-round naturalist" alive to-day, his existence is due to accident or poverty. Poverty has kept a few lovers of nature away from college, and by this seeming misfortune they have escaped the fate that would have overtaken them had they possessed the means of placing themselves under our modern teachers of biology. These teachers have deflected into other channels many a born naturalist and are responsible for the perversion of the science of biology. While deluding themselves with an exaggerated notion of the supreme importance of their methods, they have advanced no further than the architect who rests content with his analysis of brick, mortar, and nails without aspiring to erect the edifice for which these materials are necessary.

In trying to reconstruct a general naturalist at the present day, I would rather have the farmer's boy who knows the plants and animals of his own home than the highest graduate in biology of our leading university. The enthusiastic boy, whose love for nature prompts him to collect the birds, insects, or plants within reach, can be easily induced to take up the study of other groups, and thus become a local "faunal naturalist." After acquainting himself with the home fauna and flora, he may develop into a general naturalist if removed to another locality. The chief disadvantage in manufacturing naturalists in this way is that they lack the education possessed by college-bred men — a want sorely felt in after years.

To be well equipped for his work, a naturalist or biologist needs a college education; he needs laboratory instruction in modern

methods of biologic research; he needs practical training in systematic and faunal zoölogy and botany with special reference to the extent of individual variation in species, the modification of species by food and environment, and the nature and constancy of specific characters in different groups; he should have the benefit of lectures on the principles of biology and on the geographic distribution of life; and he should be taught to work out for himself the relationships and probable genetic affinities of the members of a few well-selected genera in different groups.

The teacher and professional student who aspire to tread the higher paths of biology are unworthy of their chosen field unless they possess a broad and comprehensive grasp of the phenomena of living things — a grasp that comes only after years of patient study and personal familiarity with animals or plants. Perhaps the true explanation of much of the prevalent kind of biology may be found in the circumstance that a considerable proportion of our teachers are the output of a few institutions in which their studies have been guided by section cutters and physiologists. They are well trained in methods of research in limited fields, which training may be acquired in the brief space of three or four years, but are ill fitted to impart a knowledge of the leading facts and principles of biology, or of the kind of biology likely to prove most useful to the average student.

Some of our universities encourage and support the most abstruse and recondite investigations in the field of pure science, without regard to an economic outcome — for which they deserve the greatest credit — but such studies are rarely suited to the requirements of the ordinary college curriculum. On the contrary, the tendency of the times in matters of instruction is to render undergraduate courses more practical, so that the knowledge acquired may be useful in after life. With this end in view, it may not be amiss to inquire how the kind of biology now commonly taught compares with systematic and faunal zoölogy and botany? Will anyone attempt to maintain that 10 per cent of the present teaching is of any value in after life, except to the specialist, or that more than one per cent of the students taught biology become specialists? It seems clear, from the standpoint of availability in the ordinary walks of life, that the prevalent kind of biology teaching is a failure. Systematic and faunal zoölogy and botany, on the other hand, while fully equal to the branches now taught as a means of mental discipline, have in addition an economic value, and are sources of permanent interest and happiness to the majority of mankind. Huxley, in one of his early public lectures, said: "To a person uninstructed in natural history, his country or sea-side stroll is a walk through a gallery filled with wonderful works of art, nine-tenths of which have their faces turned to the wall. Teach him something of natural history, and you place in his hands a catalogue of those which are worth turning round. Surely our innocent pleasures are not so abundant in this life that we can afford to despise this or any other source of them" ("Lay Sermons, Addresses, and Reviews," London, 1870, pp. 91-92). Not only are excursions into the country or to the sea thus made more enjoyable, and the tedious delays at the railway station converted into sources of entertainment and profit, but even much of the drudgery and routine of everyday life may be turned to good account. Instead of the mental stagnation that naturally follows the automatic performance of a monotonous daily task, there is an incentive to observation that stimulates the intellect and results in the agreeable acquisition of knowledge. In short, acquaintance with our common animals and plants appeals to an inherent desire to know more of nature in the aspects commonly presented to our senses; it increases the joys and lightens the burdens of life; it promotes the healthy expansion of the intellect and the development of the nobler impulses and sentiments, making better men and better women.

Another argument in favor of a knowledge of systematic and faunal zoölogy and botany is that it largely increases the amateur element in science and brings the great mass of the intelligent public nearer the technical specialist, thus creating that interest in and appreciation of scientific research that leads to liberal endowment. The kind of biology now taught in most of our educational institutions has the opposite effect, tending to deepen the chasm between the people and the specialist. So long as an unfathomable abyss separates science from the intelligent citizen, just so long may the specialist expect to lack the earnest support on which his success so much depends.

The study of systematic and faunal zoölogy and botany may seem superfluous to the physiologist, histologist and technical specialist who are content to contribute their mite to the general fund — a not unworthy ambition — but to those who aspire to solve the problems and master the principals of biology a broader view is necessary — a view that can come only to those who possess an intimate personal acquaintance with the interrelations of living species and the nature and extent of their modifications — for how is it possible to form a clear conception of the operations of natural selection, of the effects of environment on species, of the transmission of acquired characters, of special adaptations, fortuitous variations and so on, without first knowing something of the species themselves? It is true that a few section-cutting physiologists, possessed of speculative minds, have ventured to enter the domain of philosophic biology, but it would be ungracious to contrast their productions with those of such naturalists as Humboldt, Darwin, Huxley, Wallace, Haeckel, Agassiz, Hyatt, Cope, Dall, Allen or Ward.

In order to avoid the possibility of being misunderstood, I wish to reiterate what has been already said in substance, namely, that while the present paper is intended as a plea for systematic biology, no complaint is made against the proportionate teaching of physiology, histology, and embryology, but only against the exclusive or disproportionate teaching of these branches, as if they comprised the whole of biology. And it may be added for the benefit of those who insist that the term biology should be restricted to the phenomena of life rather than the phenomena of living things, that, while unqualifiedly opposed to this narrow view, my present purpose is not to discuss the meaning of words, but to show the necessity of remodelling the current one-sided courses of instruction by the addition of systematic and faunal zoölogy and botany, with a view to the development of a broad and comprehensive school of biology, worthy of the age in which we live.

In my judgment, university training in biology should comprise:

1. *Elementary instruction in general biology*, including cell structure and the structure of the less complex tissues of animals and plants. This involves laboratory work with the microscope and insures the necessary knowledge of microscopic technic.

2. *Lectures on morphology, taxonomy, and the relationships* of the major groups of animals and plants, both living and fossil, supplemented by laboratory work which should be restricted to the study of types and should keep pace with the lectures, if possible.

3. *Systematic work in widely separated groups.* This work must be done in the museum or laboratory, and may be supplemented by lectures. It should include the higher vertebrates as well as invertebrates and plants. In the case of advanced students, original work should be encouraged, particularly revisions of genera.

4. *Faunal work*, consisting of the study of the life of limited areas. Care should be taken to avoid too comprehensive an undertaking; and the groups chosen for study should be selected, as a rule, with reference to the literature or specimens available for comparison. The necessary field-work, if impracticable during the college year, may be done in vacation. Whenever possible, field excursions should be made at frequent intervals during the college year, under competent supervision.

5. *Lectures on the distribution of life.* In time, paleontologic distribution; in space, geographic distribution. These lectures should be illustrated by maps, diagrams, and specimens. Access to zoölogical and botanical gardens and museums is of the utmost importance.

6. *Lectures on the principles and philosophy of biology*, comprising evolution, heredity, migrations, special adaptations, and so on.

Botany and zoölogy should be taught separately under the second and third headings, and together under the first, fifth and sixth. Under the fourth heading they might be taught either separately or together, as most convenient.

Paleontology should form an inseparable part of biology and should not be taught under geology except in its stratigraphic relations. Fossil types should be studied in connection with their ancestors and their nearest living relatives.

The pendulum has swung too far in the direction of exclusive microscopic and physiologic work. When it swings back (and I believe the time is not far distant) the equilibrium will be restored — the perverted meaning of the term "biology" will be forgotten, and the present one-sided study of animals and plants will give place to a rational biology and to the development of a school of naturalists far in advance of those who have passed away.

NOTES ON PENNSYLVANIA GERMAN FOLK-MEDICINE.

BY W. J. HOFFMAN, M.D., WASHINGTON, D.C.

WHILE collecting material relating to the folk-lore of the Pennsylvania Germans I obtained some curious beliefs pertaining to the rattlesnake, and the alleged remedies employed for curing those bitten by this reptile. Many newspaper reports are annually circulated in various portions of the Atlantic Coast States to the effect that the reporter had discovered a veritable "mountain doctor," well versed in the secret properties of plants, and that this personage was widely celebrated for his wonderful skill in curing rattlesnake bites, but that the remedy was preserved with the utmost care as a great and valued secret; or, perhaps, that the reporter of the article had received a sample, but through some unavoidable misfortune he had lost it, etc.

Having consulted with some of these so-called "mountain doctors" to obtain and exchange matters of interest — during the past twenty years — it has been found that nearly all of them employ numerous species of plants for the ills that come under their observation, but that only a few are really acknowledged as possessing a semblance of skill, and still less who are familiar with so-called snake-bite remedies.

The plant employed by one of these "mountain pow-wows," and the only one claimed to possess any virtue, is *Sanicula marylandica*, or sanicle, termed by the natives "master-root," because it "masters the rattlesnake venom." The fresh plant and roots are pounded and soaked in boiling milk, when the mixture is applied to the wound as a poultice. A decoction of the same plant is also taken internally to induce diaphoresis. The decoction is said to be more efficacious if made with milk instead of water. I believe this to be the first instance of bringing this plant to public attention, at least as employed by these superstitious herbalists, and for the purpose stated; but as so much stress is placed upon the good results, even by people of recognized intelligence and education, it might not be amiss to have made a series of chemical and therapeutic experiments to test the efficacy of the remedy.

Another remedy employed by the superstitious of the mountain regions of middle and eastern Pennsylvania is to cut a live chicken in two, and to place the warm, raw surface of one part upon the part bitten by the snake.

Rattlesnakes are of value to the mountain doctors for several reasons. The oil, obtained by draining the reptile after skinning is used to cure deafness. The rattle, suspended from a string, and worn by a baby, will have the power of preventing the wearer from having convulsions during dentition. The tongue of the snake, when worn in the glove, will have the power of compelling any girl, who grasps the gloved hand, to love the one so greeted, even should she ordinarily be indifferent to his attentions.

Finally, to secure rattlesnakes, the "doctor" grasps a silk handkerchief at one corner, and allowing the other end to hang toward the serpent, teases her until she strikes it with her fangs, when he immediately raises the handkerchief from the ground, thus depriving the snake of any opportunity of disengaging herself therefrom, as the slightly recurved fangs are hooked in the material. The "doctor" then either kills the serpent by first grasping her neck with the disengaged hand, so as to prevent her biting him, when he cuts off her head. Should he desire, however, to keep the snake as a curiosity or for sale, he will extract the fangs with a small pair of forceps.

NOTES AND NEWS.

PROFESSOR RICHARD A. PROCTOR, the well-known astronomer and writer, died in 1889, of yellow fever, in New York City. His children were in Florida at the time, and could not be present at the funeral. No suggestion of a resting-place being forthcoming, the astronomer's remains were buried in the undertaker's private lot in Greenwood. The body, it was understood, was to remain there until other arrangements could be made. The lot was in an out-of-the-way part of the cemetery, and the grave was neglected, there being not even a stone to mark the place. The children of the astronomer are all making their own living, and while their wish was to bury their father better, the means were not at hand. Recently, through the efforts of Mr. Edward W. Bok, attention has been called to the matter, and Mr. George W. Childs of Philadelphia, has, with his usual generosity, purchased a lot in Greenwood, near the Flatbush entrance, to which the astronomer's remains will be removed, and in October it is hoped that a suitable sarcophagus of granite will be dedicated with due ceremony.

— The U. S. National Museum has recently come into possession of a very remarkable collection of petrified trunks of an extinct species of tree belonging to a family of plants that is now very rare, but which once formed a prominent feature of the landscape of nearly all countries. These plants are intermediate in appearance between tree-ferns and palms, and have as their best known living representative the common sago-palm, *Cycas revoluta*, of our greenhouses. The fossil trunks above mentioned are from one to three feet in height and from six inches to two feet in diameter. They are in a very perfect state of preservation, turned to solid stone of a brown color. The largest one weighs 900 pounds, and is the largest object of the kind ever reported from any part of the world. They were found lying on the surface of the ground in the vicinity of Hot Springs, South Dakota, and were all sent to Washington by mail under the frank of the Interior Department. The geological formation in which they occurred is not known with certainty, but this class of plants reached its greatest perfection in what is known as Secondary, or Mesozoic time. It is therefore altogether probable that these trunks grew at that remote age and have lain strewn over the plains for millions of years waiting for science to gather them in and make them help tell the story of the earth. They have been placed in the Department of Fossil Plants, in charge of Prof. Lester F. Ward, who recently superintended the taking of fifteen views of them by the accomplished photographer of the National Museum, Mr. T. W. Smillie. This is one of the most important accessions the museum has received of late, and when the collection is elaborated and the results published it will make a valuable contribution to science.

— At Denison University, Granville, Ohio, a new scientific building, known as Barney Hall, is approaching completion. The building, which is one of the most substantial scientific buildings in the West, will cost when finished about $65,000, and will include chemical and physical laboratories, as well as a museum and laboratories of biology. Special attention is to be devoted to neurology and comparative neurology. An extended graduate course in biology, and a number of fellowships have been provided with corresponding increase in faculty.

—"The Story of My Life," by Dr. Georg Ebers, is the title of a delightful autobiography, full of fascinating reminiscences, which will be published immediately by D. Appleton & Co. This autobiography tells of Dr. Ebers's student life in Germany, his association with movements like that for the establishment of kindergarten training, his acquaintance with distinguished men like Froebel and the brothers Grimm, his glimpses of revolutionary movements, his interest in Egyptology and the history of ancient Greece and Rome, and the beginnings of his literary career.

— Without making invidious comparisons, it is safe to say that the exhibit which Messrs. Houghton, Mifflin & Co. have arranged in the gallery in the northwestern corner of the Department of Liberal Arts in the Manufacturers' Building at Chicago is in all respects worthy of somewhat careful examination. The idea evidently is to represent such a library as might be found in the house of a man of cultivation in any part of the United States.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

CONGRESS OF CHEMISTS AT CHICAGO.

THE committees in charge of the congress have selected Monday, Aug. 21, as the date of the opening of the Congress of Chemists to be held in connection with the Columbian Exposition, in Chicago. The chairman of the committee appointed for coöperation in this congress by the American Association for the Advancement of Science, Chemical Section, is Professor Ira Remsen, Johns Hopkins University, Baltimore, Md. The chairman of the committee appointed by the American Chemical Society is Dr. Wm. McMurtrie, 106 Wall Street, New York, N.Y. The chairman of the committee of the World's Congress Auxiliary, on Congress of Chemists, is Professor John H. Long, 2421 Dearborn Street, Chicago, Ill. The various committees have organized by selecting Dr. H. W. Wiley, chief chemist of the Department of Agriculture, Washington, D.C., as chairman, and Professor R. B. Warder, Howard University, Washington, D.C., as secretary.

The work of the congress has been divided into ten sections, and a temporary chairman has been selected for each section, as follows: Agricultural Chemistry, H. W. Wiley, Department of Agriculture, Washington, D.C.; Analytical Chemistry, A. B. Prescott, Michigan University, Ann Arbor, Mich.; Didactic Chemistry, W. E. Stone, Lafayette, Ind.; Historical Chemistry and Bibliography, H. C. Bolton, University Club, New York.; Inorganic Chemistry, F. W. Clarke, Geological Survey, Washington, D.C.; Organic Chemistry, I. Remsen, Johns Hopkins University, Baltimore, Md.; Physical Chemistry, R. B. Warder, Washington, D.C.; Physiological Chemistry, V. C. Vaughan, Michigan University, Ann Arbor, Mich.; Sanitary Chemistry, H. Leffmann, 715 Walnut Street, Philadelphia, Pa.; Technical Chemistry, Wm. McMurtrie, 106 Wall Street, New York, N.Y.

General and special invitations have already been issued to foreign chemists, and many replies have been received, indicating a large attendance of chemists from abroad at the congress. The following distinguished foreign chemists have already promised to present papers to the congress, and the list will, without doubt, be increased many fold before the date of the opening: Professor L. G. M. Ernest Milliau, Marseilles, On Standard Methods of Oil Analysis; Mr. Farnham Maxwell Lyte, London, On the Production of Chlorine; Mr. H. Droop Richmond, London, On the Accuracy of the Methods of Analyses of Dairy Products; Mr. Pierre Manhes, Lyon, subject to be announced later; Professor B Tollens, Goettingen, Researches on the Synthesis of Polyatomic Alcohols; Professor Ferd. Tiemann, Berlin, subject to be announced later; Mr. H. Pellet, Brussels, On the Methods of Determining the Percentage of Sugar in Beets; Mr. H. R. Proctor, Leeds, On the Examination of Tanning Materials; Mr. O. Kemna, Antwerp, On the Purification of Water; Mr. Otto Hehner, London subject to be announced; Professor C. A. Bischoff, Riga, subject to be announced; Professor G. Lunge, Zürich, On the Method of Teaching Technological Chemistry at Universities and Polytechnic Schools; Professor Ludwig Mond, Rome, subject to be announced; and Professor W. N. Hartley, Dublin, subject to be announced.

American chemists are invited to take an active interest in the congress and to be present, or, if that is not possible, to send papers on some of the subjects indicated in the classification above mentioned.

Chemists specially interested in each of the subjects for discussion are invited to correspond with the chairmen of those sections in regard to the character of the work and of the papers expected. All chemists who expect to read papers at the congress are earnestly requested to send the titles thereof to the chairman of the General Committee, Dr. H. W. Wiley, Department of Agriculture, Washington, D.C., on or before the first day of August. It will be difficult to arrange for a position on the programme for the titles of any papers which may be received after that date. The time required for each paper should also be noted, so that daily programmes can be provided for in advance. In all cases the place of honor on the programme will be given to foreign contributors. Papers or addresses can be presented in English, French, or German, as the author may select, but where convenient the English language will be preferred.

The committee desires to ask those chemists who propose to attend the World's Congress to make an excursion during the week previous to the meeting to Madison, Wisconsin, for the purpose of attending the meetings of the Chemical Section of the American Association for the Advancement of Science. This will not only be a delightful excursion, as Madison is distant only about four hours from Chicago, but will also enable the participants in the congress to make the acquaintance of the scientific men of the United States and other countries engaged not only in chemical, but also in other branches of science.

Other attractions in Chicago will be meetings of different chemical societies. Among these may be mentioned the American Chemical Society, the annual meeting of which will begin Aug. 21, and the Association of Official Agricultural Chemists, which will hold its annual meeting in Chicago, beginning Thursday, Aug. 24. The sessions of these societies will be so ordered as not to conflict with the business of the congress. The American Pharmaceutical Association, which has a strong chemical section, will also meet in Chicago at or near this time. It is hoped that the Institute of Mining Engineers may also hold its meeting about this time, although no definite announcement can be made in regard to this matter. It is thus seen that this occasion will bring together the active workers in all branches of chemical science in the United States, and enable American chemists to make the acquaintance of distinguished co-laborers from abroad, and the visiting chemists to meet the largest possible number of their fellow-laborers here.

Every possible arrangement will be made for the convenience and comfort of visitors. Intending participants in the congress should address Professor John H. Long, 2421 Dearborn Street, Chicago, Ill., for information in regard to quarters and other accommodations. On arrival in Chicago visitors should report at once to the congress headquarters, Art Institute Building, Lake Front and Adams Streets, where full information will be given them in regard to matters connected with their personal comfort. Wherever possible, intending visitors should write a few days before their arrival to the committees above mentioned, in order that special provision may be made for their comfort when they reach Chicago.

In regard to the climate of Chicago in August, much can be said in praise. While warm days may sometimes be expected, the situation of the city on the edge of a vast, open prairie, extending for nearly a thousand miles north and west without a break, secures even in the hottest day refreshing breezes which cool the atmosphere and mitigate the heat of summer. The lake breezes also do much to render the climate moderate. No one need be deterred from attending the congress on account of fear of severe heat.

It is especially urged that all chemists who intend visiting the World's Fair take this occasion to do so, by which they can combine the pleasure of visiting the Exposition with the benefit derived from attendance at the congress. To American chemists an especial appeal is made to be present for the purpose of welcoming our foreign visitors and showing them the progress of chemical science in the United States.

HARVEY W. WILEY.

THE EFFECT OF FOOD UPON THE COMPOSITION OF BUTTER.

BY FRED W. MORSE, DURHAM, NEW HAMPSHIRE.

Practical dairymen, who produce a high grade of butter, lay great stress upon the quality of food with which their cows are fed. Chemists, who have had much to do in the examination of butter for adulterants, have observed that the samples from one region have steadily varied in their composition from those of another region, where different practice prevailed in feeding. These facts have led to many experiments, both in Europe and America, to find out the specific action of different foods upon the composition of butter.

This product of the dairy is composed of fat, water, salt and curd; and of these, the cow is responsible for only the fat and the curd. The former constitutes about eighty-five per cent and the latter barely one per cent of the butter, therefore chemical examinations for variations due to food have been confined wholly to the fat. Butter-fat differs from the fat deposited in the body of the animal by having from five to seven per cent of volatile fatty acids, and only eighty-seven to ninety per cent of insoluble, fatty acids, while tallow has ninety-five per cent of the latter and less than one-half of one per cent of the former. The volatile acids give butter fat its characteristic flavor, and also cause it to be softer than tallow. Butter fat also differs from tallow in having less oleic acid among its insoluble acids. These two characteristics of butter-fat have been studied more than any of its other properties, because of their relations to adulterations, and the studies of food effects have so far been confined to the same lines.

In the course of investigations, it has been found that in general, the widest variations in volatile acids and oleic acid are due to the progress of lactation, the latter increases and the former decrease as the period advances. Individual cows also vary widely from one another in the composition of their butter fat, but with regard to the breeds, no definite conclusions can be made.

The effect of food is greater upon the oleic acid than upon the volatile acids and, in nearly all cases, variations in this constituent of the fat have been closely related to variations in the firmness of the butter. This is to be expected, as oleic acid is an oily liquid at summer temperature, and the butter is softer or harder as this acid is present in greater or less amount.

Many of the foods have been tried in such limited amounts that it is unsafe to draw conclusions, therefore only such foods will be mentioned here as have been used in repeated trials. The most notable effect has been produced by cotton-seed and cotton-seed cake. Whenever it has been fed, the volatile acids and oleic acid have been depressed below the average; the butter is deficient in flavor and often too hard to be easily cut with a knife.

In strong contrast to this action of cotton-seed, is the effect of gluten-meal, a by-product from the manufacture of corn-starch. This food is especially effective in raising the oleic acid above the average, and also produces a butter-fat high in volatile acids. The butter from this food is frequently too soft for an ideal product. Corn-meal, however, has always produced a butter-fat low in oleic acid, but has shown no action on the volatile acids. Clover, dry or green, has produced fat high in volatile acids, and with oleic acid slightly above the average. The same is also true of spring pasturage. Early cut straw generally produces a fat with volatile acids and oleic acid below the average.

The action of clover and pasturage in increasing the volatile acids, and that of corn in lowering the oleic acid, explains the practice of the makers of first-class butter, who rely upon these foods to produce a good flavor and firm grain.

ELECTRICAL NOTES.

THE present Electrical Exhibit at the World's Fair contains much more that is of interest from an engineering standpoint than from a purely scientific one. Magnificent as the engineering display is, there is little that is new. Everything is now thoroughly mechanical, one no longer sees the monuments of tortured ingenuity which used to pervade the former exhibitions; in its place are the results of sound and competent engineering skill.

The multipolar machine has evidently come to stay. Three years ago there was not, I believe, a single large multipolar machine made. Almost the only makers of machines above 100 horse-power were the Edison, Brush, and Westinghouse Companies (we are speaking of America, of course; on the Continent of Europe multipolar machines have been the rule), and their machines were all bipolar. Now there is on exhibit hardly a single machine above 50 horse-power which is not multipolar. Splendid examples of these are the Westinghouse, Thomson-Houston, and Edison direct connected generators.

The general use of the toothed armature is also a new feature. A short time ago the hardy individual who should have proposed designing a large dynamo with toothed armature would have been told that it was impossible to do it, that the consequent increase of self-induction would make it spark so badly that it could not be run, that the only way to make a dynamo whose brushes would not need shifting between full and no load was to have a big air-gap, and all this would have been backed up by alarming mathematical quotations from Ayrton and other writers.

Now we see that the impossible way is the only way, and the designer who neglects the aid of the toothed armature is handicapping himself very much. In passing, one may notice that, if one may judge from several recently-read papers in the English Institute of Electrical Engineers, European designers are not able as yet to design a toothed armature which shall not spark, shall require no shifting of brushes, and shall be highly efficient. Even the machines, which probably furnished the encouragement to American designers to try the toothed armature, i.e., the Brown machines for electro-metallurgy, we learn, recently, had to be sent back to the factory, the armature turned down, and rewound with an exterior winding.

Among the new things in engineering, the large two-phase 1,000 horse-power generators of the Westinghouse Company deserve especial attention. The large amount of work now being done in this line by the various companies is a good augury for the rapid development of the system. If this proves a success, the days of the continuous current will be ended, so far as engineering is concerned. There are three things so far which have hampered the alternating current: (1) Poor all-day efficiency of transformers, (2) noisy arc-lights, and (3) absence of motors. The recent developments in transformer design have resulted in transformers with an all-day efficiency of 94 per cent; the new low-potential arc-lamps give a better light than the continuous-current lamps, and as noiseless; and there only remains the development of the motor system, which now seems to be within sight.

Electric welding is evidently no longer a thing of the future. There are a number of firms making displays, who are using the Thomson process in their business. Several of the wagon-making firms use the welders to make tires and weld axles; wire-making companies use them to join lengths of wire; they are used in making shells for modern machine and quick-firing guns; for joining up lengths of pipe in ammonia ice-machines; and for welding rails together to form a continuous track. This last is a most interesting exhibit, as, if successful in practice, it will lead to a new method of railway construction, for street railways at least. A track has been in operation for some time near the Thomson-Houston factory in Lynn, and the results seem to have been very good. No trouble was experience from expansion or contraction, the friction of the rails in the ground preventing displacement and creeping, and the expansion merely manifesting itself as a stress in the rails, well within the elastic limit.

Among recent practical applications of electricity are the electric chimes and tower-clock system, now on exhibition in the tower in the centre of the Manufactures and Liberal Arts Building. These are the invention of Mr. Attwood, and the chimes have been used for

some time in Grace Church, New York. In this system the hammers of the bells are worked from a key-board, like that of a piano, and the largest sized bells can be played as easily and quickly as a piano itself. The mechanism is very simple, the keys making contacts which actuate relays, and these in turn excite solenoids with iron plungers, to which are attached the bell ropes. Instead of the key-board, a small cylinder, like that of a music-box, can be used, which automatically plays the chimes every hour or quarter.

The most valuable part, however, is the electric tower-clock arrangement. In this, instead of the ordinary cumbersome clock-movement requiring frequent rewindings, an ordinary clock is used, which may be placed anywhere, in an office, for instance. Every minute this clock makes a contact, which actuates a little battery motor, and this turns the hands of the tower-clock one minute ahead. As the impulse is given at the middle of the minute, the tower hands are never more than half a minute out of time. The actuating clock may be synchronized from Washington if desired. This system seems to give a very good tower clock for a fraction of the present price. One advantage is the fact that no winding is required, six or seven Leclanche cells furnishing enough current to run the clock for several years.

Another exhibit which will be gladly hailed by those who have had to do much telephoning will be the automatic telephone exchange in the gallery of the electrical building. In this system, the telephones are the same as usual, but in front of the wooden box which supports the transmitter are placed a number of keys. If a subscriber wishes to call up number 1324, for instance, he presses key number 1, once; key number 2, three times; key 3, twice; and key 4, four times. He then presses another key, and if the subscriber he wishes to communicate with is talking to some one else, it signals him that fact; if the line is open, it puts him in communication. When he is through, he presses the key again, and it disconnects him.

Several central offices have been put in, and are working satisfactorily, and a number of other cities have decided to replace their present central office by this automatic system.

At present there is one disadvantage which the system has, i.e., the need of four wires instead of two; but, from an examination of the machines, there seem to be several ways by which two wires could do all the work, and doubtless this improvement will soon be made. Even with the increased expense, the better service will more than compensate for the increased cost in wiring, and, of course, the central station expenses will be much reduced.

A very complete exhibit is that of the Bell Telephone Company. This includes an interesting historical exhibit of the various forms of telephone receivers and transmitters invented by Mr. Bell. A central station is shown at work, the methods of connecting up the lines, etc.

One of the new things is the use of paper insulation for telephone cables. Seemingly impracticable as this seemed to be a few years ago, it is now a complete success. Of course, it is evident that its low specific inductive capacity gives it marked advantages over any other kind of insulation, and that by its use speech could be made clearer, and transmitted further, but it would at first sight appear that it would be difficult to keep up its insulating qualities. This, however, has been done, and nearly every switchboard observed was wired with this insulation. The operation of putting it on the wire is shown in the Electrical Building. R. A. F.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Peculiar Nesting of a King-Bird.

A CURIOUS incident, showing a peculiarity of bird-life, came under my notice within the last month (June, 1893). We have been boring an artesian well about five miles south of Beaumont, mound rising out of the great coastal prairie lying between Beaumont and Sabine Pass, in Jefferson County, Texas, and in the course of the operations have built a derrick about seventy-five feet high. After the derrick had been built a few weeks, it was visited by a great number of birds of various kinds, whether with a view of locating or not, I do not know, but one would think a well outfit, with all its noise and wet, a very unfavorable location for bird-life. Among the visitors came a pair of king-birds (*Tyrannus tyrannus*), which, after an apparently careful inspection, became convinced that they had found a satisfactory location for their home. A sheltered point, where two of the cross-beams came together in a corner of the derrick about twelve feet from the ground, was selected and the pair began building a nest. Notwithstanding the noise of the machinery and the continual passing up and down of the man in the derrick (the nest was built in the same corner as the ladder is located on the outside of) the nest was completed and three eggs deposited. Then something occurred that killed the female, and the male, after moping around for a day or two, also disappeared. That, I thought, was the end of that pair's nesting; but apparently not, as in a day or two the same male bird returned, bringing with him another mate. The outlook was again considered, and the pair began building another nest in the same location, resting the new nest on the top of the old one, building, as it were, a second story to it. After the new nest was completed, but before any eggs had been deposited, wondering what could have become of the eggs already laid, I went up the derrick, and, carefully raising the new structure, brought out the old eggs. Replacing the new nest as best I could, the birds continued to occupy it, and the female is now setting upon a full nest of eggs of her own laying, and I am now looking forward with considerable interest to the advent of a young brood to see how they will thrive under the circumstances.

I have asked several of my ornithological friends if such an occurrence has anywhere come under their observations, but have in all cases received a negative answer. WM. KENNEDY.

Austin, Texas, June, 1893.

The Tucumcari Fossils.

IN *Science*, May 26, pp. 282–283, there is an article by Mr. W. F. Cummins of the Texas Geological Survey, entitled "Geology of Tucumcari, New Mexico," in which he says: "Mr. Marcou . . . endeavors to avoid the conclusion (that the beds are Cretaceous) by saying that either the determinations of the fossils found by me were incorrect or that they did not come from that locality, and suggests that the labels on my packages were loosely put on and became mixed with collections made elsewhere; and on this flimsy subterfuge (to give it no harder name) still insists on the correctness of his reference to the Jurassic."

Mr. Cummins tells at length of the good care he took not to have any confusion of labels. So my suggestion cannot stand. I accept fully the explanation.

Now there remain two points, which are the most important: First, the correctness of the determination of the fossils; second, the stratigraphic position of the Jurassic strata of the Tucumcari between the Trias and the lower beds of the Neocomian, at Comet Creek, an affluent of Washita River, and at the great band of the Canadian River.

1. Mr. Cummins says: "myself and my assistants discussed the fossils in the field as we picked them up, and our note-books show that we then determined them as they are now designated." . . . "I made up small suits and sent them to various parties for determination, . . . and there was unanimous agreement as to all the species I have *published*." It is important to add an explanation as regards the species *published*. Only one species has been published by Mr. Cummins, a leaf of a fossil plant; all the invertebrate fossils are only quoted, without descriptions or figures. Here is the list given by Mr. Cummins:—

"*Gryphoa dilatata*, var. Tucumcarii Marcou; *Ostrea marshii*, as determined by Marcou, but in reality *Ostrea subovata*, Shumard; *Gryphoa pitcheri*, Morton; *Exogyra texana*, Romer; *Ostrea quadriplicata*, Shumard; *Trigonia emoryi*, Con.; *Cardium hillanium*, Sow.; *Cytheria leonensis*, Con.; and a single leaf of a dycotyledonous plant, which I described and figured under the name

Sterculia drakei. It will be apparent to everyone acquainted with the fossils of the Cretaceous that those enumerated belong only to Cretaceous strata."

It would have been well if Mr. Cummins had given the names of the "parties," as he calls the experts, for in no other part of geology is it so important to know the paleontologists who determined the fossils. When in the field in 1853 I determined the *Gryphœa* as the *Gryphœa dilatata*, or a variety of it, of the Oxfordian of Europe, and the *Ostrea* as a *Ostrea marshii* of the Lower Oolite of the Jura. After my return from the field, I submitted my fossils to Louis Agassiz, Alcide d'Orbigny, de Verneuil, d'Archiac, Pictet, etc. M. de Verneuil, an excellent paleontologist, as well known in America as in Europe, reported on my fossils before the National Academy of Science of France, and called them *Gryphœa dilatata* and *Ostrea marshii;* and he refers the Tucumcari strata to the Jura. Finally, I have given long descriptions and excellent figures of the two fossils in my volume, entitled "Geology of North America," and also in *Bulletin Société Géologique de France*, vol. xii., 1855. So my two fossils had received all the attention possible, and can be regarded with safety as correctly determined.

Let us see now what guarantee we have as to the correctness of the determination by Mr. Cummins and his "various parties for determination" of his fossils, as he calls his anonymous paleontological assistants. The value of determination of fossils depends much on the name of the paleontologist employed. To be sure, anyone, even the greatest paleontologist, makes mistakes; but it is generally admitted that they are less liable to errors than others. Mr. Cummins is unknown as a practical paleontologist. Until three years ago, he was regarded as a collector of fossils in Texas who has supplied two paleontologists, Messrs. Cope and C. A. White. It this case Mr. Cope has nothing to do, for all the fossils are invertebrates. Mr. White has charge of the Mesozoic invertebrate fossils at the U. S. National Museum, and Mr. Cummins, in a letter to me, says that he did send his Tucumcari fossils to Washington for determination. So it may be assumed that Mr. White is one of the experts, who has agreed to the determinations made by Mr. Cummins. Now Mr. White, during twenty years, has constantly confounded, in all his paleontological memoirs, the *Gryphœa dilatata*, var. *tucumcarii*, with the *Gryphœa pitcheri;* and more, he has said, in some of his papers, that the Lower Cretaceous of Europe has no representative in North America.

As regards my other fossil, the *Ostrea marshii*, which, according to Messrs. Cummins and White, "is in reality *Ostrea subovata*, Shumard." I shall quote from a letter of Mr. Cummins to me, dated Feb. 25, 1892: "I have compared the Tucumcari specimens with *O. subovata*, Shumard, and do not believe they are the same." And I shall tell what occurred in my house during the last visit of Mr. White, in 1884. Mr. White took up a fossil on my chimney mantel-piece, looked at it attentively, and exclaimed: "What a beautiful Cretaceous fossil; it is the most perfect I have ever seen from Texas." My answer was: "The fossil is not Cretaceous; it is the typical *Ostrea marshii*, picked up, with my own hand, in the Lower Oolite of the Jura Mountains at Frickberg, in Argovia, Switzerland." Every one can draw his conclusions as to Mr. White's ability to determine specimens of the *Gryphœa dilatata* and *Ostrea marshii* types.

I have said already before in another paper, and repeat it, that it is impossible to find the typical *Gryphœa pitcheri* (I mean the one described and figured in my "Geology of North America," Plate iv., Figs. 5 and 6) in the same bed with the *Gryphœa dilatata*, var. *tucumcarii*, and the *Ostrea marshii* of Pyramid Mount, on the Tucumcari area.

As to the *Exogyra texana* quoted by Mr. Cummins, it is an incorrect determination of a fossil having some distant affinity of forms. The four or five other fossils in Mr. Cummins's list, are, at all events, not sufficiently characteristic, even if properly determined, for "the conclusion that the beds are Cretaceous."

2. As to the stratigraphic position of the Jurassic strata of the Tucumcari, it is so clear and so striking that a few words will dispose once more of the question. At the Tucumcari there is no discordance of stratification or interruption of any sort between the Trias beds below and the Jurassic beds above. It is a continuous series, with most striking differences in the lithology and paleontology between what is Trias and what I call the Jura. How far those deposits extended eastward and southward, it is difficult to say in the present condition of our limited knowledge of the geology of Texas. Very likely they did extend eastward all over the Indian country of the Commanches, Kioways, Kichais, and Delawares, as far as near Topofki Creek and Delaware Mount; southward they went as far as the upper part of the Trinity River basin, and covered all the upper Brazos and upper Colorado Rivers of Texas. After their upheaval above the sea, at the end of the Jura period, erosions on a great scale occurred and swept away all the Upper Trias and a part of the Middle Trias to such an extent as to reduce the plateau of the Jura Trias nearly to the actual Llano Estacado, obliging it to recede from the vicinity of Topofki Creek several hundred miles westward. Then over the eroded part of the Middle Trias, at Fort Washita, at Comet Creek, and at the Great Band of the Canadian River, an arm of the Lower Cretaceous sea, extended in a narrow strip, as a sort of gulf, which extended as far north as southern Kansas, according to Mr. Cragin's discoveries.

In that gulf, strata, mainly of limestone, were deposited; and at Comet Creek, on the Washita River, where I saw it in 1853, those limestone rocks are a perfect mass of *Gryphœa pitcheri*, with some *Caprotina texana* at the base of the formation. The division of the Texas Cretaceous, to which those "*Gryphœa pitcheri* limestones" belong, has been called since "Fredericksburg Division," and are the homotaxis or equivalent of the Lower Neocomian of Europe, as I have always said ever since.

Mr. Cummins says there is no disagreement between him and Mr. Hill as to the age of the strata of the Tucumcari, which are referred by them to the "Denison beds" of the "Washita Division;" that is to say, a group of strata far above, and consequently younger, than the Comet Creek beds with *Caprotina* and *Gryphœa pitcheri*. So, according to Messrs. Cummins and Hill, the Tucumcari strata, which they call "Denison Cretaceous beds," were deposited in perfect concordance on the top of the Upper Trias, and long after the deposit of the Fredericksburg Division at Comet Creek. A material impossibility, against all stratigraphic and paleontologic principles of formation in a flat country over immense plains; for there is no doubt that the Neocomian strata of Comet Creek, deposited in interrupted discordance over the strata of the Middle Trias, are younger than the strata of Tucumcari, deposited in perfect concordance of stratification, without any interruption, over the uppermost part of the Upper Trias.

What a strange story, unique in the annals of geographical geology. A description of the Tucumcari area, made simply during a difficult and even then dangerous exploration, with all the proofs, stratigraphic, paleontologic, and lithologic, has stirred up an opposition without precedent as regards its long duration. Now — June, 1893 — it is forty years since I started from Boston for my exploration by the thirty-fifth parallel, for a Pacific railroad from the Mississippi River to the Pacific Ocean; and, although one concession has been made in my favor, by almost all my adversaries — the correctness of my reference of the lower beds of the Tucumcari to the Trias — the opposition continues, with a degree of intensity and, I am sorry to say, of unfairness never equalled.

Mr. R. T. Hill, after his two visits at the Tucumcari, in 1888 and 1891, has not yet published anything reliable, only a few contradictory statements, without proofs and against plain stratigraphic and paleontologic facts.

Mr. A. Hyatt, after a thorough exploration of two months' duration of a part of the Tucumcari area in 1889, asked me to look over with him his quite extensive collection of fossils, and placed before my eyes his detailed sections of Monte Revuelto. I did not see a single fossil in his collection which can be called a Cretaceous fossil; when, on the contrary, the *Gryphoa* and *Ammonites* had all the most indisputable characters of Jurassic fossils.

For some unknown reasons, not only the report of his exploration has not been published, but even his administrative report as head of a special exploration of the U. S. Geological Survey, in

which each explorer gives, every year, the summary of the work done to the director of the survey, has not yet been issued, although the volume in which it ought to be inserted was printed three years ago. The stopping of the distribution of the "Eleventh Annual Report" is somewhat mysterious. Two other printed Annual Reports, the twelfth and thirteenth, remain also undistributed, waiting for the distribution of the eleventh.

Mr. A. Hyatt, in a printed letter in *The American Geologist* for April, 1893, p. 281, admits that his verbal opinion, quoted by me at page 213 of the same periodical, "is correct;" but that he had "at present absolutely no opinion about the age of rocks of this region." A rather curious conclusion for an explorer who has passed two months on the same ground where I was only two days, and who has studied the collection of fossils he made during a whole winter.

Evidently there is some secret about it. My old adversaries, almost all alive now, with the exceptions of the two Shumards, Meek and Newbery, are still at work against me. But I have resisted their combined attacks during forty years, and I can continue very well the defence of my observations and opinions.

However, I shall say nothing more for the present, waiting until after the publication, by some paleontologist, of the fossils collected at the Tucumcari by Messrs. Hill, Hyatt, and Cummins, with descriptions and good figures; for it is absolutely useless to discuss any longer, without proper documents in the hands of geologists, in order that everyone interested in the question may be able to judge for himself as to the conclusions arrived at by the different parties. JULES MARCOU.

Cambridge, Mass.

Natural and Artificial Cements in Canada.

YOUR issue of March 31, 1893, contains an article on "Natural and Artificial Cements in Canada," which in part is incorrect, and I wish to set you right with regard to the class of raw material from which the "Star" Portland cement is manufactured

In the first place, Star cement is manufactured from shell marl, which is thoroughly decomposed, and containing from 95 to 98 per cent pure carbonate of lime, the clay used is an alluvial blue clay.

The analyses of our clays and marl show them to be of superior quality and equal to any deposits of a similar nature; this has also been fully demonstrated in the practical results obtained by users of the cement when manufactured. E. BRAVENDER.

Napanee Mills, June 12.

Sound and Color.

On reading Professor Underwood's paper on the above subject in *Science* for June 16th, some rather peculiar experiences of my own, which I have never read or heard of in others, were freshly brought to mind.

When intently listening to certain, but by no means all, eminent speakers, and to a few operatic singers of great renown, I have for some years past distinctly detected, or rather have involuntarily become conscious of, an emanation of color from the head of the speaker or singer with each distinct tone of the voice. The more impassioned the words and tones the more intense the color, and the larger the visible aureole or color area. The color has thus far been limited, with a few exceptions, to a transparent and ethereal but decided blue. It emanates suddenly with each explosion of sound, passes upward like a thin cloud of smoke, and fades like a swiftly dissolving view. I noticed it for the first time while listening to Professor Felix Adler, later on when listening to Colonel Ingersoll, faintly over the head of William Winter; again quite distinctly in case of General Sherman and General Horace Porter, faintly in case of some other public speakers, including Anna Dickinson, Helen Potter, the elocutionist, and some eminent divines, but not at all in case of President Cleveland and some other equally prominent public men.

In case of singers, the most noted instances I can recall are the DeRetszke brothers, Jean and Edward, Mdme. Emma Eames, Lilli Lehmann, Mdme. Albani, Vogel, and Gudehus.

In case of Mdme. Lehmann the blue color verged towards a liquid green, and with Albani it was a pale sheen of silver vapor. In case of Vogel, the tenor, the aureole was an evanescent and very pale straw color. In Mdme. Mielke the blue became a velvety purple or violet. Mdme. Nordica emitted an aureole of pale, translucent gold; Emma Juch gives me the impression of a delicate and liquid pink, while Patti seemed to emit no distinguishing color, but rather a kaleidoscopic blending of many colors.

I should be glad to hear from others who have noted similar phenomena, for I have been inclined to question the reliability of my own impressions, vivid as they have been, and many times repeated. Professor Underwood's recital inclines me to accord them a little more respect. SAMUEL S. WALLIAN, M.D.

Washington Heights, City.

Age of Guano Deposits.

THE following particulars, recently given me by a friend who, years ago, was a sailor, and whom I know to be a man of the strictest veracity, may be of interest as possibly throwing some light on the age of guano deposits.

In the year 1840 his vessel loaded with guano on the island of Ichabo, on the east coast of Africa. During the excavations which were necessary, the crew exhumed the body of a Portuguese sailor, who, according to the head-board, on which his name and date of burial had been carved with a knife, had been interred fifty-two years previously. The top of this head-board projected two feet above the original surface, but had been covered by exactly seven feet of subsequent deposit of guano. ROBERT RIDGWAY.

U. S. National Museum, Washington, D.C., June 13.

Correction.

IN 1887 I published in the *Canadian Record of Science* an account of a Permian glacial moraine in Prince Edward Island. I have recently examined this formation more carefully, and am not at all positive about its age. The bedding and jointage are conformable with the underlying formation, but the cementing material is purely calcareous, and the induration, though complete, may be recent. In the absence of organic evidence, I do not think we can positively say that this conglomerate is not Quaternary. F. BAIN.

North River, P. E. Island.

BOOK-REVIEWS.

Geological Survey of Missouri. Vol. II. A Report on the Iron Ores of Missouri. By FRANK L. MASON. Jefferson City, December, 1892. Plates, Map, etc. 366 p.

Vol. III. A Report on the Mineral Waters of Missouri. By PAUL SCHWEITZER Jefferson City, December, 1892. Plates, Map, etc. 256 p.

THERE are but few States in the Union that have not had at some time or other geological surveys of a part or the whole of their territory. As a general rule, the surveys have been conducted by different geologists, the same one seldom holding his position for a long period, and, in point of fact, the survey itself frequently ending before a decade has elapsed. There are, of course, notable exceptions to this, Minnesota, for example, where the State geologist has issued twenty annual reports, and New York, which has enjoyed an almost uninterrupted existence since 1836. Yet more remarkable in this latter case is the fact that the present head of the survey has been such for nearly fifty years and was one of the original corps in 1836. This veteran, as everyone knows, is Professor James Hall, still one of the most indefatigable of all American geologists.

The State of Missouri has had numerous surveys, which have been carried on under various heads. The first survey existed from 1853 to 1862, and published five reports; the second lasted from 1870 to 1874, and issued four reports; the third from 1876 to 1879, and published only one report; while the fourth has lasted from 1889 to date, and has published three bulky volumes, of which the present ones are two, five bulletins, an atlas of maps, and a biennial report. We thus see that under the present management more work has been done than in any of the other surveys lasting twice as long.

In Vol. II. of the reports Mr. Mason has given much valuable information relative to the iron ores. In his introductory remarks he discusses the forms in which iron occurs and the relative value of the various ores. He then takes up the kinds found in Missouri, describes their distribution, and examines in detail coarse and fine specular ore, limonite, red hematite, carbonate, and bog ores. In this discussion, various facts are brought out of interest and value to geologists and students of physical geography. For example, it is concluded that the strata lying about the Archæan outcrops of the Ozark Mountains are of Cambrian age instead of Lower Silurian, as they have been almost universally considered. An excellent description is given of Iron Mountain, Pilot Knob, and other large deposits of ore, and this is followed by an account of the probable origin of the ore beds. The veins are regarded as veins of infiltration, fissures occurring in the rocks having been filled by the solvent action of percolating water through iron-bearing porphyries. The changes produced in topography of pre-Cambrian time by this action of water are briefly sketched as follows:—

"In the first place, whatever the origin of the porphyries, it is allowable to imagine the porphyry region to have been, in pre-Cambrian times, mountainous, or at least hilly. These hills and valleys must have had cracks or fissures in the rocks as we find them to-day. Naturally, erosion or weathering and denuding agencies would begin at the highest points. The products of disintegration would wash from the higher to the lower points. Iron dissolved from the decomposed rocks would, by means of percolating waters, find its way to the fissures in the unweathered rocks at a lower point. In these fissures it would be precipitated, either chemically, by coming into contact with alkaline or other reagents, or would, by slow absorption of oxygen, be made insoluble. This in time would fill the crevices and fissures in the lower rocks with a substance much less susceptible to weathering influences. The rock-mass thus cemented would, as a whole, also tend to resist weathering more effectually than the rock not thus protected. Iron deposits filling fissures would not be formed at the highest points, since solution would tend to carry it either deeper into the hills or into the valleys below. The result of this would inevitably be that the erosive agencies would be much more effective on the elevated portions of the country than on the lower. Gradually the hills would tend to reach the valley level; the valley country, being protected by iron dykes and veins, would resist such erosion. The final result would be that in many cases the hills would be changed to valleys and the valleys to hills" (pp. 57-58).

An interesting account of the Ozark uplift occupies one of the chapters. The region generally goes by the name of the "Ozark Mountains," but it is mountainous in name only. It is an elliptical, dome-shaped elevation, about 140 miles wide and about 200 miles long. Its greatest elevation is about 1,100 feet The average slope to the southeast is a little more than one degree, while to the northeast it is less. The region may be divided into (1) plateau, (2) hilly or "mountainous," and (3) river bottoms. In the plateau region the rivers have their origin. The surface is mostly gently rolling, well-drained, and not steep enough to prevent easy tillage. Following the streams down in either direction the bluffs grow higher and higher, the streams more numerous, and there is soon reached a country cut by deep cañons, or gorges, with steep-walled divides. This is the "mountainous" region, but when one climbs to the summit of the divide, instead of a commanding view, there appears to be a plain spread out on all sides. The "mountain" crests are all at the same level. Floating down the streams the bluffs and hills grow higher and higher, but the fact is soon apparent that, instead of mountains and hills having been thrust up, the plateau has been etched into relief by the streams. The river bottoms begin in the mountain region, at first of little value or extent, but gradually widening out to from one-half to two miles. Here the hills lose their sharp crests and steep slopes, and the bottoms rise gradually by an easy slope to the uplands.

Throughout the region the streams are peculiar. In many cases they spring directly from the foot of a tall cliff and begin at once to cut their gorges. These grow deeper, the walls frequently rising, by a succession of precipices of from 50 to 100 feet, to a height of 500 feet. The courses of the streams are very tortuous. At one place the Osage River flows a distance of seventeen miles when it can be intersected by crossing overland only a single mile. A departure from a direct line of from three to seven miles is not at all uncommon. The absence of bowlders is also noticeable; this being due to the fact that the masses of rock falling from the cliffs are soluble limestone or friable sandstone, and both are quickly removed. The streams are also of large size, yet water courses on the surface generally have no water in them. At the same time many rise to impassable floods in a few hours. In May, 1892, the Current River rose 27 feet in about eight hours. The floods subside as rapidly as they rise, the cause in both cases being the character of the country. There is nothing to conserve the water and it runs off as fast as it falls.

Yet another feature of the region is in the large springs. One of these, called Meramac Spring, is said to flow at the rate of 10,000 cubic feet per minute. Current River rises from a spring of about equal size, and these are but two out of a large number. These springs are, of course, only the outlets of underground rivers. Sinking Creek flows for a long distance as a surface stream. "A few miles from where it empties into Jack's Fork it runs into a *cul de sac*, formed by a crescent-shaped mountain 500 or 600 feet in height. Just before reaching this mountain it sinks from sight and reappears a mile away on the other side of the mountain in the form of a large spring." Naturally, with a scant coating of soil on the hills, the vegetation is not there luxuriant. Twenty or thirty years ago the hills were reported to be bare, but now they are covered with a thin growth of jack-oak, hickory, cedar, and yellow pine. But the growth in the river bottoms, where the soil is rich, is luxuriant, the trees being close together and of gigantic height. Here are found sycamore, gum, elm, water-maple, water-birch, ash, hickory, and numerous oaks. All are so connected by a net-work of vines that it is nearly impossible to get between them.

The age of various sandstones and limestones that have been described in different Missouri reports has long been a vexed question and one that has given all who have attacked it great trouble. This question is taken up by Mr. Mason, and his conclusions may be summed up as follows:—

The geological age of nearly all of the rocks of the Ozark uplift is Cambrian, and the name "Ozark series," originally proposed by Broadhead, is adopted for them. Sandstones alternate with limestones, and these have been known as the first or saccharoidal, second and third sandstones, and the first, second, third, and fourth magnesian limestones. The saccharoidal sandstone has been generally correlated with the Calciferous of New York, and the St. Peter's of Minnesota and Wisconsin; and the magnesian limestones with the Lower Magnesian of the upper Mississippi Valley. Mr. Mason does not believe the evidence sufficient to make more than one sandstone and one limestone formation. For the first he proposes the name of *Roubidoux sandstone*, and for the second the name of *Gasconade limestone*. The outcrops of both sandstone and limestone have been correlated by lithological characters, but it is shown that the two rocks vary greatly. Sections taken along Current River for a distance of sixty miles and along the Gasconade for forty-eight miles show so much variation that it is impossible to trace the different sandstones or limestones with any certainty. There is, however, a stratum which bears fossils of the same general character over wide areas, and by its aid the connection between the sandstone and limestone can be traced. From the lists given it would appear that the affinities are more nearly with the Cambrian than the Lower Silurian epochs. The conclusions given will probably render a reconsideration of the age of certain beds at Eikie's quarry, near Baraboo, Wisconsin, necessary. These beds have been generally regarded as Lower Magnesian. They are probably more likely Potsdam. We have not space to go further into details, but we commend the volume to the consideration of geologists.

The second of our titles treats of a vastly different subject. The first part is taken up by a general discussion of mineral waters in respect to their origin, composition, etc.; and the second, by far the larger part, is devoted to a detailed account of the mineral

springs of the State, with over 150 analyses of waters. The waters are divided into muriatic, alkaline, sulphatic, chalybeate, and sulphur. The origin of each of these is briefly discussed. The methods of analyses, classification, and therapeutic uses are also considered. For those who are especially interested in analyses of water and for the citizens of Missouri and other States who desire a knowledge of the location and uses of the various springs the volume is invaluable. It is a volume to be consulted rather than one to be read. JOSEPH F. JAMES.

Washington, May 12, 1893.

A Handy Book for Brewers. Being a Practical Guide to the Art of Brewing and Malting. By HERBERT EDWARDS WRIGHT, M.A. London, Crosby, Lockwood, & Son. 530 p. 8°

MR. WRIGHT has, in the present volume, expanded and enlarged an earlier work well known to the profession, entitled, "A Handbook for Young Brewers," giving the conclusions of modern research in so far as they bear upon the practice of brewing, as well as much practical detail, manipulative and structural. Few books of the size other than mere statistical records contain the amount of information herein included, and if the author has sacrificed style to space it can not be considered a fault in this instance. The book is not intended for general reading, but for the student of brewing, and is to supplement rather than to supplant practical teaching at the works. There is much, however, that is of value to others, both to chemist and to general scientist, as witness the excellent chapters on water, the laboratory, on ferments and fermentation, yeasts, etc. The latter subjects in particular are cleverly treated, and nowhere do we remember seeing the various theories and hypotheses massed together so conveniently for comparison and ready reference. Complete details of malting and brewing operations are carefully given, differing customs are placed in juxtaposition, and in all cases the scientific discussion of chemical and vital changes accompanies the description of the process. It is unfortunate that the glossary originally planned as an appendix to the text was finally omitted, as there are few industrial operations with more technical and "shop" expressions than brewing, and the free use of these in some of the chapters — the author resting, of course, upon his intended glossary—would be rather confusing to the uninitiated. The subject is one of many ramifications, and as such could more easily be handled in three volumes than in one, but Mr. Wright has succeeded admirably with this difficult condensation, and has omitted nothing essential to a thorough knowledge of the subject.

C. P.

An Outline of the Documentary History of the Zuñi Tribe. BY A. F. BANDELIER. *Somatological Observations on Indians of the Southwest.* BY DR. HERMAN F.C. TEN KATE. *In a Journal of American Ethnology and Archæology.* J. Walter Fewkes, editor. Vol. III. Boston and New York, Houghton, Mifflin, & Co. 1892.

THE scientific work accomplished by the Hemenway Expedition is gradually becoming known to the world through the medium of Dr. Fewkes's journal. The documentary history of the Zuñis during the 16th and 17th centuries, by Mr. Bandelier, is of absorbing interest and reflects the vast labor that had been expended in its compilation. In the identification of the Seven Cities of Cibola with the ancient Zuñi pueblos, the evidence formerly adduced is made so conclusive, by the introduction of new data, that it seems impossible for any one to fail to be convinced. The events which led to the Pueblo uprising against the Spaniards in 1680 are minutely recorded. Probably half the paper is devoted to copious notes and citations from original sources — principally manuscripts now in the hands of the Expedition. On page 114, the date of Fray Juan del Bal's arrival in New Mexico is given as 1771, instead of 1671, an obvious misprint, as the missionary was killed in the revolt above alluded to.

The second part of the volume is a summary report by Dr. ten Kate of his anthropologic observations of the Pima, Papago, Maricopa, Yuma and Zuñi Indians, as well as of the human remains found in the ruined puebles of the Salado Valley, Arizona, and in one of the Cibolan cities. Although the investigations of Dr. ten Kate and Mr. Cushing were from totally different points of view they unite in the conclusion that "the pre-Columbian Arizonians were closely related to the Zuñis of to-day." In the opinion of Dr. ten Kate the types of North American Indians are not exclusively American, but present only the characteristics of the Mon-

golian. The author does not mean to imply that our Indians are strictly Mongolians, or that America has been populated from Asia, for he says "the American race is, somatologically speaking, not a type, but has characteristics which can only be called Mongoloid."

F. W. HODGE.

Washington City.

Laboratory Calculation and Specific-Gravity Tables. By JOHN S. ADRIANCE, A.M. Second editon. New York, John Wiley & Sons. Interleaved. 114 p.

IN some respects the author has in this second edition given us a new book, having enlarged the original tables and added others of importance. This increase of substance has, too, a value of its own in works such as these, being of far greater importance here than similar additions in general and descriptive works, for not only is the reputation of a book of tables based upon the accuracy of the figures, but also largely upon its completeness. We have all relied more or less upon like works for aid in laboratory calculations, and yet when certain data are found absent, how soon the book will fall into disuse entirely and make its way to the top shelves! Mr. Adriance, however, himself a consulting chemist and fully alive to the necessities of the case, has chosen not only such tables as are in constant use, but also those of frequent or less frequent need, covering extraordinarily well the field of ordinary chemical analysis. Such a work as this is of true assistance, and despite the claim urged by some chemists as to the possible introduction of error when using "ready-made results," we believe the chance of error to be greater when these same results have to be calculated under the strain of physical fatigue, following a long day or night of analytical or experimental work. Naturally all tables of factors, and all data of this kind, should be proven in moments of leisure, and in important cases, notably those involving legal testimony, they should be thrown aside altogether; but for daily use in the laboratory, they are invaluable in the saving of time and mental labor. Not only is the substance of the book "good," but in appearance it is neatness itself, each word and figure is clear-cut and distinct, an element highly important in tabular statements. The book is interleaved and ample opportunity thus given the chemist for additions and remarks.

C. P.

Chemical Theory for Beginners. By LEONARD DOBBIN, Ph.D., and JAMES WALKER, Ph.D., D. Sc., Assistants in the Chemistry Department, University of Edinburgh. London and New York, Macmillan and Co., 1892. 240 p.

Of the vast number of text-books bearing upon chemistry, we have but few treating of its foundation or theory. The smaller works merely touch upon theoretical discussion, while the larger treatises presuppose an extensive knowledge of the same. It is then a fact that only those students with the advantages of able instruction and scientific associations arrive at a really clear understanding of the ground-work of chemical notation, reaction and law. "Students enter the laboratory at once," is a familiar phrase in many college announcements, and there are excellent arguments for such a custom, provided a thorough study of theory accompanies the practical demonstration. More often, however, in general science courses the theory is disposed of in one or two brief lectures, all effort being concentrated upon a rapid advance into the field of "the elements, their compounds, their characteristics and reactions."

The above work is, we believe, rather unfortunately named, for while it will be easily understood by a beginner, and is a most excellent book for such a one, still it can and will be read advantageously by many advanced students and practical chemists. The wording is smooth and attractive, always interesting, never fatiguing; the student is carried forward, by an easy and natural progression, from the nature of things to a study of chemical action, of combustion, the laws of Boyle, Charles, and Avogadro, of density and of the atomic weights. Chemical notation is not reached until the 12th chapter, where, with the knowledge already gained, its discussion is of value and intelligible to the beginner. The later chapters contain an entirely non-mathematical exposition of the more important principles of general chemistry reviewed in the light of recent research, treating of the kinetic molecular theory, mass action, solution, electrolysis equivalence, the periodic law, etc.

C. P.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For sale at low price.—A fine old-fashioned photographic camera, rosewood box, one foot square, lenses, four inches diameter, made by C. C. Harrison. Plateholders, troughs, baths, etc., all in large wooden case, formerly the property of the late President Moore, of Columbia College. This is a fine example of an instrument of the best make for the old wet-process methods, and valuable to any institution or amateur interested in the history of photography in the U. S. Address M. S. Daniel, 236 W. 4th St., New York.

I wish to exchange a collection of 7,000 shells, 1001 species and varieties, American and foreign, land, fluviatile and marine, for a good microscope and accessories. Address, with particulars, Dr. Lorenzo G. Yates, Santa Barbara, California.

For exchange.—I wish to exchange Lepidoptera of South Dakota and other sections, for Lepidoptera of the world. Will purchase species of North America. Correspondence solicited, particularly with collectors in the Rocky Mountains, Pacific coast and Hudson's Bay regions. P. C. Truman, Volga, Brooking county, South Dakota.

For sale.—Wheatstone Bridge wire, made to order, new and unused. Price, $10. W. A. Kobbe, Fortress Monroe, Va.

For sale or exchange.—One latest complete edition of Watt's Dictionary of Chemistry, in fair condition; one thirty volume edition (9th) of Allen's Encyclopædia Britannica, almost new. Will sell cheap for cash or will exchange for physical or chemical apparatus. Address Prof. W. S. Leavenworth, Ripon College, Ripon, Wis.

Exchange.—One celestial, one terrestrial globe, one lunatettis and charts, celestial maps, diagrams and ephemeris from 1880 to 1896, astronomical works, all in good condition. Will sell cheap or exchange. Make offer. C. H. Van Dorn, 79 Nassau St., New York.

The Rev. A. C. Waghorne, New Harbor, Newfoundland, wishes to sell collections of Newfoundland and Labrador plants, all named by competent botanists. He is going on a missionary journey along the Labrador coast, from the middle of July till October, and in return for much needed aid towards (Episcopal) Church purposes in that region, will be glad to be of service to any botanists who may write to him. Letters posted in the U. S. up to July 1 will reach him at the above address, and if posted later will be forwarded.

Wants.

A GRADUATE of an American Polytechnic institution and of a German university (Göttingen), seeks a position to teach chemistry in a college or similar institution. Five years' experience in teaching chemistry. Address Chemist, 737 Cary St., Brockton, Mass.

AN experienced teacher in general biology wishes a position in a first-class college or university. Three years in post-graduate study. Extensive experience. Strong indorsements. Address E. W. Doran, Ph.D., 1327 G St., N. W., Washington, D. C.

THREE teachers wanted for a male and female seminary in central New York. Typewriting, etc., languages, mathematics, sciences, *et. al.* Send stamp with and for particulars. Box 701, Hempstead, L. I.

A ZOOLOGICAL collector and taxidermist of ten years' experience in the field is now open to engagement, for either field or laboratory work. References furnished. Address Taxidermist, Box 75, White Sulphur Springs, West Va.

WANTED.—A set of Allen's Commercial Organic Analysis, 4 vols. Vols. I. and II. particularly desired. Condition not important, all leaves being present and in place. Address Charles Platt, 34 Lewis Block, Buffalo.

WANTED, as principal of a flourishing technical school, a gentleman of education and experience who will be capable of supervising both mechanical and common school instruction. Special familiarity with some technical branch desirable. Address, giving age, qualifications, etc., J. B. Bloomingdale, Fifty-ninth street and Third avenue, N. Y.

WANTED.—A young man as assistant in our microscopical department. Queen & Co., Philadelphia.

THE undersigned desires specimens of North American Gallinae in the flesh for the study of their pterylosis. These species are especially desired: *Colinus ridgwayi, cyrtonyx montezumae, dendragapus franklini, lagopus welchi, tympanuchus cupido* and *pedioecetes phasianellus*. Any persons having alcoholic specimens which they are willing to loan or who can obtain specimens of any of the above are requested to communicate with Hubert Lyman Clark, 3922 Fifth Avenue, Pittsburgh, Pa.